Two-Dimensional Antiferromagnetic Fractons in $Rb_2Mn_cMg_{1-c}F_4$ with c close to the percolation concentration

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An inelastic neutron scattering experiment on the two-dimensional Heisenberg antiferromagnet in $Rb_2Mn_cMg_{1-c}F_4$ with c close to the percolation concentration was performed at 1.5 K well below T_N = 19.5 K using the IRIS spectrometer at ISIS with the energy resolution of ΔE = 17.5 μeV. The dispersion relation of observed magnetic fractons was well fitted to $E(q) \sim q^z$ with $z = 1.8 \pm 0.1$. The dynamical exponent ($z = D_f/d$) was in very good agreement with the fractal dimension D_f for this system, and therefore the spectral dimension was concluded to be d =1, as predicted by the numerical study. Also, the peak intensity of observed magnetic fractons was well fitted to $A(q) \sim q^{-y}$ with $y = 2.9 \pm 0.1$. In the single-length-scaling postulate (SLSP), the dynamical structure factor can be scaled as $S(q,\omega) = q^{-y}F[q\Lambda(\omega)]$ with an energy dependent length scale, $\Lambda(\omega)$. Assuming $\Lambda(\omega) \sim \omega^{-1/z}$ and using the determined values of y and z, this scaling was confirmed.